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THE NEXT FIFTY YEARS[1]

By President ROBERT M. HUTCHINS

UNIVERSITY OF CHICAGO

THE task which Mr. Harper and his associates set themselves fifty years ago was that of organizing a university. To them a university was, like the German university of that time, an institution dominated by the spirit of inquiry. The characteristic activity of its professors was research.

The task involved selecting men qualified for research, giving them facilities for it, assembling students who could take part in it, and erecting that protection of academic freedom about it which, in the bad old imperial days, guaranteed the independence of the teaching and investigations of the German professor.

[1] An address delivered at the Fiftieth Anniversary Convocation of the University of Chicago on September 29.

The University of Chicago was a university the day it opened. We are now so used to universities that we are apt to think that this achievement, though doubtless unusual, was not very remarkable. We are apt to think that all it required was money and that anybody could have done it if he had had the money that was available to the organizers of the University of Chicago.

But the money was not available. Mr. Rockefeller's original pledge was for $600,000, and it was conditional on the raising of $400,000 more. We later became so used to great gifts for universities that we now suppose that all the participants, including Mr. Rockefeller, must have expected him to give the enormous sum of $35,000,000 which he did give by 1910. But

in 1891 all the funds of Harvard amounted to not much more than seven millions. All the university had fifty years ago was a contingent pledge of $600,000. The courage of Mr. Harper and his colleagues must be measured by what they had.

Within the memory of living men there was no such thing as a university in this country. Graduate instruction had begun at Yale in the seventies. Harvard was getting under way. But neither was a university, as Chicago understood it, in 1891. Clark, which was having difficulties which Mr. Harper did nothing to alleviate, and Johns Hopkins, which had started fifteen years before, were the only American universities in the Chicago sense. Mr. Harper had originality as well as courage.

The founders succeeded in what they set out to do. They won the battle they fought, and we are the beneficiaries of their victory. We take universities as a matter of course. Even the taxpayers are now willing to support institutions which Mr. Harper would have recognized as great universities. The American university is established.

To the question, "When you get your organization, what are you going to do with it?", the founders of the University of Chicago replied, "We are going to conduct research with it." To say that this answer is unsatisfactory is not to depreciate the accomplishment of those who gave it. It was satisfactory then. American education had begun to suffer from premature senescence. It was rejuvenated by the spirit of inquiry. That spirit, too, has produced the brilliant achievements of American scholarship, which alone justify the toil and treasure that have been lavished upon the American universities, the popular devotion they have commanded, and the faith of the founders of the University of Chicago.

The time of the founders was one of conscious or unconscious agreement upon the ultimate foundations of society and the ultimate purposes of the individual. Though men differed sharply, they differed not so much about their destination as about the methods of arriving at it. They would have been shocked to hear from any responsible person that morality was a matter of opinion, the state an end in itself or God the product of wishful thinking. They did not need to heed the warning of Socrates that the unexamined life was no life for man, because the examination had been conducted long before, and its results were imbedded in the tradition which guided the daily action of men. The American university did not need to reformulate the ideals which should animate mankind, and still less to suggest that ideals were important. All that was needed, men thought, was more knowledge to enable them to reach the goals which they more or less clearly had before them. The University of Chicago was founded to provide that knowledge. It was to supply the means to improve a civilization the main lines of which were laid down and the aims of which were taken for granted by those who enjoyed its blessings.

In those areas in which the last half century has brought no change in the fixity and clarity of beliefs the American university has surpassed the highest hopes of its founders. People still want material goods; and through the natural sciences we can now produce a range and luxuriance of such goods that would embarrass a Roman emperor. People still want health; and through the American university we may sometime achieve a longevity comparable to that of the heroes who flourished before the Flood. Wherever we know what we want, wherever we want it badly enough, the knowledge acquired by research can help us get it.

But no matter how we may struggle to deceive ourselves, we vaguely feel that bodily goods and external goods are not the ends of life. They are means to other goods beyond them. Now we no longer join in conscious or unconscious agreement on the nature and existence of the other goods beyond. The last half century has substituted confusion and bewilderment for the simple faith in which Mr. Harper, Mr. Rockefeller and their collaborators embarked upon their enterprise at Chicago. That civilization which we thought so well established seems on the verge of dissolution. The religious belief which led the Baptists to found this university does not sustain its constituency to-day. Instead of feeling that we were born with a common inheritance of ideas about the purpose of the state and the destiny of man, we listen to competing affirmations of contradictory positions on these issues without being able either to accept or deny them in a manner satisfactory to ourselves. Confronted by the great question of peace or war, we can not make up our minds what we want to defend, why or how. Though the death rate is declining, we do not know what to do with our lives.

Since we are confused about ends, we do not know how to employ means. Though our means of improving the material conditions of existence exceed those of any previous generation, we could not use them, in the great depression, to save our fellow-citizens from starvation and despair. The means of improving the material conditions of existence are now diverted to the extermination of mankind on a grander scale than ever before.

Gibbon, in his celebrated chapter summarizing the reasons for the fall of the Western Empire, relieves the fears of Europe by saying that there will never be another barbarian conqueror. His reason is simple. War now requires the knowledge of a large number of arts and sciences. Hence to excel in war the barbarian must cease to be barbarous. Since man first

discovered how to master the forces of nature all history has been tending toward this goal. Gibbon's final remark is, "We may therefore acquiesce in the pleasing conclusion that every age of the world has increased and still increases the real wealth, the happiness, the knowledge and perhaps the virtue of the human race."

The conclusion is pleasing; the premise is false. Professor Nef's researches show that the rate of increase of real wealth is rapidly declining. Though knowledge has grown from more to more, happiness and virtue have not. And we see that a barbarian conqueror equipped with knowledge is more barbarous, as well as more dangerous, than any of his unlettered predecessors.

The centrifugal forces released through the dissolution of ultimate beliefs have split the universities into a thousand fragments. When men begin to doubt whether there is such a thing as truth or whether it can ever be discovered, the search for truth must lose that precision which it had in the minds of the founders of the University of Chicago. If we doubt whether man is rational, we can not lightly put our trust in the exercise of reason. And if the traditional notion of freedom, when dragged up out of our subconscious, looks less impressive than we had always supposed it would; if we think on the one hand that freedom is doing as one likes, and on the other that man is a mere automaton, free inquiry ceases to be that infallible guide to terrestrial salvation which Mr. Harper thought it was. After fifty years we must confess that the beacons established to illuminate the pathway of our people give a light that is flickering and dim. The universities, instead of leading us through the chaos of the modern world, mirror its confusion.

If we are to do for our own day what the founders of the University of Chicago did for theirs, we shall have to continue what they did, and we shall have to do something more. We shall have to recapture, revitalize and reformulate for our time the truths which gave purpose and significance to their work. We are in the midst of a great moral, intellectual and spiritual crisis. To pass it successfully or to rebuild the world after it is over we shall have to get clear about those ends and ideals which are the first principles of human life and of organized society. Our people should be able to look to the universities for the moral courage, the intellectual clarity and the spiritual elevation needed to guide them and uphold them in this critical hour. The universities must continue to pioneer on the new frontiers of research. But to-day research is not enough either to hold the university together or to give direction to bewildered humanity. We must now seek not knowledge alone, but wisdom.

This is what the University Grants Committee of England meant when it said: "Here arises the responsibility of the universities. They are the inheritors of the Greek tradition of candid and intrepid thinking about the fundamental issues involved in the life of the individual and of the community, and of the Greek principle that the unexamined life is no life for man."

Candid and intrepid thinking about fundamental issues—in the crisis of our time this is the central obligation of the universities. This is the standard by which they must be judged. This is the aim which will give unity, intelligibility and meaning to their work. This is the road to wisdom. Upon that road the American university will regain its own soul and bring hope and comfort to a distracted world.

HYPOTHESIS AS TO THE ORIGIN OF COSMIC RAYS AND THE EXPERIMENTAL TESTING OF IT IN INDIA AND ELSEWHERE[1]

By Dr. R. A. MILLIKAN, Dr. H. V. NEHER and Dr. W. H. PICKERING

CALIFORNIA INSTITUTE OF TECHNOLOGY

THE hypothesis here adopted as to the mode of origin of the cosmic rays makes possible the prediction of five definite vertically incoming cosmic-ray bands. As the observer moves north from the magnetic equator each of these five bands should begin to reach the earth at a particular latitude and continue reaching it at all more northerly latitudes. Between each latitude of first entrance of a band of particular energy and the latitude of first entrance of the band of next lower energy there should be found a plateau of constant vertically incoming cosmic-ray energy. Four such plateaus should be experimentally observable.

The hypothesis rendering possible these predictions rests upon five major discoveries made by the workers in the Norman Bridge Laboratory of Physics at the California Institute at Pasadena. These discoveries are (1) that more than 60 per cent. of all incoming cosmic-ray energy is of the nature of incoming

[1] From a symposium celebrating the Fiftieth Anniversary of the University of Chicago, the American Association for the Advancement of Science collaborating.

charged-particle bullets (either electronic or protonic), each of energy between 2 billion electron volts and 15 billion electron volts; (2) Neddermeyer and Anderson's discovery of the production by nuclear impacts within the atmosphere of mesotrons which serve as the chief carriers of the cosmic-ray energy down to the lower levels of the atmosphere; (3) Bowen's remarkable discovery that atoms, when out in interstellar space, are able to undergo atomic transformations forbidden to them within the stars, and (4) Bowen and Wise's discovery that in ring nebulae, trillions of miles away from the exciting star, and therefore presumably reflecting conditions in interstellar space, there are five of the atoms, namely, helium, carbon, nitrogen, oxygen and silicon, each of which is more than ten times more abundant than any other atom save hydrogen (which must be excluded from measurable cosmic-ray effects because of the smallness of its rest-mass energy); and (5) Lauritsen and Fowler's discovery in the Kellogg Radiation Laboratory that a part, at least, of the rest-mass energy of an atom has the power under suitable conditions of transforming itself directly into the creation of a positive-negative charged-particle pair.

The hypothesis made in view of these five discoveries is that while the evolution of energy by the stars is maintained, as Bethe has recently shown, by the *partial* transformation within the stars of the rest-mass energy of hydrogen into radiant energy through the building of helium, carbon and other atoms out of hydrogen, and the release through this process of the so-called "packing-fraction" energy, the energy of cosmic rays on the other hand is maintained by the occasional *complete* transformation in interstellar space of the rest-mass energy of the atoms of helium, carbon, nitrogen, oxygen and silicon (and even heavier aggregates) into cosmic rays, each such event presumably creating either an electron pair or a proton pair (these two events are indistinguishable by our geographic experiments), though an occasional photon pair, or neutron pair, need not *necessarily* be excluded.

The foregoing hypothesis requires that the cosmic rays of measurable energy reveal a spectral distribution of five distinct, definitely measurable bands as follows: (1) a band of rays each having an energy of 1.9 billion electron volts produced by the annihilation, or complete transformation, in interstellar space, of the rest-mass energy of the helium atom; (2) a carbon-atom-annihilation band of energy 5.6 billion electron volts (b.e.v.); (3) a nitrogen-atom band of energy 6.6 b.e.v.; (4) an oxygen-atom band of energy 7.5 b.e.v., and (5) a silicon-atom band of energy 13.2 b.e.v.

The hypothesis requires further that there should be in India, for vertically incoming rays between the magnetic equator and magnetic latitude about 20 degrees N. a plateau of unchanging cosmic-ray intensity with latitude; it requires another such plateau between the latitudes of entrance of the bands due to the silicon and oxygen atoms; it requires a third such plateau between the great band produced by the annihilation of the carbon, nitrogen and oxygen atoms, and that due to the annihilation of helium; and, finally, it requires a fourth such plateau north of Bismarck, North Dakota, where as the observer goes northward the helium band should first be able to get vertically through the blocking effect of the earth's magnetic field and should then be able to enter the earth in full strength at all more northerly latitudes.

The experimental evidence that has been so far obtained in India and elsewhere for the existence of these five bands and four plateaus may be thus summarized. The India evidence seems to be good for the existence of the plateau of constant cosmic-ray intensity from the Equator up to Agra (17 N) and for the appearance just north of Agra of a band that can be identified with that due to silicon. There is some evidence for the existence of the flat plateau just north of the latitude of first entrance of the hypothetical silicon band. There is unambiguous evidence for the entrance at about the computed latitude of a very strong band at between 5.5 and 7.5 b.e.v., and this we tentatively identify with the joint carbon, nitrogen, oxygen bands which, however, we have not yet been able to resolve. There is a little evidence for the existence of a plateau of constant cosmic-ray intensity between the latitudes at which the carbon and the helium bands should appear, and there is fair evidence, too, for the existence of a flat plateau north of the latitude of entrance of the hypothetical helium band, the real existence of which may be stated to have been rendered probable. Not only are all the predicted latitudes in reasonable agreement with the observations, but also the observed intensities are of the right order of magnitude.

Further experiments are being made to see whether better designed apparatus will render the nature of the evidence better or worse for the hypothesis, and new experiments in Mexico and the United States are planned for the coming months.

This comparison of prediction and experiment has been made possible largely through the generous support of the investigation by the Carnegie Corporation of New York and the Carnegie Institution of Washington. The success of the work in India was made possible by the extraordinarily generous and complete cooperation of the British Indian Meteorological Service.

THE DEPARTMENT OF ASTRONOMY OF THE UNIVERSITY OF CHICAGO

By Dr. OTTO STRUVE

YERKES OBSERVATORY

THE University of Chicago is celebrating this month its fiftieth anniversary. As a part of this celebration the Yerkes Observatory organized in September a symposium on "Astronomical Spectra," which followed immediately after the annual meeting of the American Astronomical Society. The speakers at the symposium were Dr. R. C. Williams and Dr. L. Goldberg, of Michigan, Dr. R. Wildt and Dr. H. N. Russell, of Princeton, Dr. D. H. Menzel, of Harvard, Dr. M. Schwarzschild, of Columbia, Dr. P. W. Merrill and Dr. R. Minkowski, of Mount Wilson, Dr. A. B. Wyse, of Lick, Dr. G. P. Kuiper, Dr. W. W. Morgan, Dr. P. Swings and Dr. O. Struve, of Yerkes. The discussion ranged from the theory of radiative transfer in stellar atmospheres by Menzel to the peculiar behavior of forbidden emission lines in "symbiotic" stars (*i.e.*, in stars consisting of two or more components of different physical characteristics) by Merrill. Wildt presented new and important ideas concerning continuous absorption by molecules in stellar atmospheres, and Russell reviewed the latest data on the relative abundances of the elements, a problem which has a special bearing upon Bethe's cycle of energy generation. Williams presented the observational results obtained by him and by other workers on the energy distribution of continuous stellar spectra and stressed some serious discrepancies which still exist in the ultraviolet region. Wyse presented new spectroscopic results secured at the Lick Observatory for faint planetary nebulae and discussed the abundances of the elements in these objects. Goldberg discussed the theory of atomic line intensities and gave a comparison of the results obtained from wave mechanics with the observed intensities. Schwarzschild discussed the theory of pulsating stars. Morgan developed the classification of stellar spectra and Kuiper gave his latest summary of observations of several thousand stellar spectra—culminating in a preliminary table of relative abundances of different species of stars in the galaxy. Swings outlined the properties of Wolf-Rayet stars from recent observations at the McDonald Observatory. Minkowski summarized the Mount Wilson observations of supernovae and Struve outlined a working hypothesis for the interpretation of extended stellar atmospheres.

The discussions were exceedingly lively and the attendance was unexpectedly large. We can not hope that each symposium will lead to such a rapid and dramatic climax as the discovery in the laboratory and the identification of interstellar CH^+ by Douglas and Herzberg a few weeks after the Yerkes conference on interstellar molecules,[1] last June, but there can be no doubt that the active workers in stellar spectroscopy who attended the symposium derived much valuable information and inspiration.

Although the Yerkes Observatory was officially dedicated in October, 1897 (at this occasion a conference of astronomers was held at Williams Bay, which organized the American Astronomical Society), the department of astronomy of the University of Chicago also marks its fiftieth anniversary. Exactly fifty years ago Professor George E. Hale undertook at the Kenwood Observatory in Chicago his epoch-making photographic observations of solar prominences and of flocculi on the disc of the sun. In a letter which Mr. Hale wrote in 1923, on the occasion of the twenty-fifth anniversary of the Yerkes Observatory, he described this period in the following words ". . . I must find a way to photograph the solar prominences without an eclipse. When this had been done at Kenwood in the autumn and winter of 1891–92, and when it appeared that a promising opportunity for progress lay in the study of the flocculi which I had found and photographed on the face of the sun, I determined that I must have a larger telescope—one that would carry powerful spectroscopes and spectroheliographs and would give a large image of the sun suitable for the study of the structure of spots, flocculi and prominences."

Apparently the idea of building a large telescope for the University of Chicago came early in 1892. Hale had been corresponding with John A. Brashear, the famous lens maker of Pittsburgh, about a 12-inch photographic objective to serve as a twin for the visual lens which he had obtained for the Kenwood Observatory. The glass had been ordered in 1891 from Mantois in France, but there were various delays in casting the disc, and on March 1, 1892, Brashear suggested that "our American friends are casting a 20-inch flat and if we carry out our wishes we will exhibit a 20-inch objective made of American glass at Chicago." Evidently, the Columbian Exposition of 1893 served as a powerful stimulus to telescope makers, as well as to astronomers! Brashear was seriously ill in the spring of 1892 and during the following summer he undertook a trip to Europe. On

[1] *Astrophysical Journal*, 94: p. 381, 1941.

July 5 he wrote to Hale saying that the Saint Gobain people had quoted a price of $1 per kilo on a 30-inch disc. "Hence a 30-inch disc, 4 inches thick will cost about $135. . . ." In September, 1892, Mr. Charles T. Yerkes agreed to finance the construction of a large telescope, and two forty-inch discs, originally made by Mantois for the University of Southern California, were purchased when it was learned that this institution would not require them. The mechanical parts of the telescope were completed by the Warner and Swasey Company of Cleveland in 1893. The great lens was tested in the optical shops of the makers—Alvan Clark and Company of Cambridgeport, Massachusetts—in October, 1895, and the first astronomical observations were made by Mr. Hale and his associates in the summer of 1897.

OBITUARY

WALTER GRANGER

ONE of the great paleontologists and one of the best-loved men of his generation was taken from us on September 6, 1941, when Dr. Walter Granger died suddenly at Lusk, Wyoming. As for several years past, he had gone to South Dakota to collect fossils with his old friend and colleague Albert Thomson. After attending a field conference of the Society of Vertebrate Paleontology, in the recent organization of which he was active, he was on his way back to the Big Badlands when stricken.

He was born in Middletown, Vermont, on November 7, 1872, the son of Charles H. and Ada Byron Haynes Granger. With little formal schooling, he came to New York as a boy in 1890 and obtained work as an assistant in taxidermy at the American Museum of Natural History, the institution to which he devoted all the rest of his life. His first duties, often graphically recalled, included cleaning the oil lamps along a pathway to the museum and similarly menial tasks. More interesting pursuits were bird and mammal collecting and preparation, in which he acquired permanent skill, occasionally making skins even in his last years.

In 1891 the late Henry Fairfield Osborn came to the museum to establish the Department of Vertebrate Palaeontology, and five years later, in 1896, Professor Osborn had the promising young Walter Granger transferred to this department. Here he worked as an assistant until 1909, then as an assistant curator, 1909–1911, and associate curator, 1911–1926, becoming curator of fossil mammals in 1927. In recent years and until the time of his death he was also curator of paleontology in the Department of Asiatic Exploration and Research. Without academic training, he acquired his knowledge the hard way, but so extensively and so thoroughly that he was a recognized scientific authority in his field as well as a great collector, a fact signalized not only by his rise on the scientific staff but also in 1932 by an honorary D.Sc. from Middlebury College in his native state.

Among his first expeditions was participation in the excavation of Bone Cabin Quarry, Wyoming, beginning in 1897, which resulted in the famous *Brontosaurus* skeleton and other important dinosaurian material. His first scientific publication, a joint paper with Osborn in 1901, was on this collection. In 1903 he was placed in charge of Eocene and Paleocene collecting, and he was in this field every summer from 1903 to 1906, from 1909 to 1914 and in 1916 and 1918. In these years he obtained large collections from almost every known early Tertiary formation of the West. Overshadowed in the public eye by later Asiatic collecting, this work nevertheless was and remains of the utmost importance. It laid the basis for new conceptions and more adequate knowledge of the beginning of the Age of Mammals and resulted in the most remarkable series of primitive mammal remains that has yet been assembled. From the first, and throughout his career, he was not only a collector successful in finding and skilful in preserving specimens, but also a stratigrapher of high rank. His careful observations have played an essential part in the faunal zoning and correlation of much of the Mesozoic and Cenozoic of two continents.

His first foreign expedition was to the Fayûm of Egypt under Professor Osborn in 1907. With the reorganization and expansion of the Museum's Asiatic program in 1921, he was made paleontologist of the Central Asiatic Expeditions and second in command with Roy Chapman Andrews. Aside from the main work in Mongolia, he also collected in Sze-chuan when the party was not in the Gobi. Most of his time was spent in Asia from 1921 through 1931. After 1931 he remained in charge of the preparation and study of the fossil collections of the expedition and in recent years was editor of its publications in all fields, one of the principal tasks in which he was engaged during his last months.

The superb central Asiatic collection resulted from the conjunction of an unparalleled opportunity and a man uniquely qualified to profit by it. Central Asia was the last major untouched storehouse of paleontological riches. Among the thousands of fossils collected, practically every one represented an animal hitherto unknown and vital new evidence of the pageant of ancient life. Some of these specimens are already among the most widely known of fossils: the

dinosaur eggs and the amazing series of skulls and skeletons of the dinosaurs that laid them, the tiny skulls of Mesozoic mammals, titanic *Baluchitherium*, largest of land mammals. Aside from these and other spectacular discoveries, there is case after case of teeth, jaws, skulls and skeletons, truly a whole new world resurrected from the past.

This achievement was the climax of his life, and duties in the museum, increasing with Matthew's retirement in 1927 and with Osborn's death in 1935, prevented any more major expeditions. Field work remained his greatest joy, however, and he missed no opportunity to spend a few weeks each summer working with some party in the field.

It is probably as a collector, certainly one of the greatest, that he will be best remembered in the history of paleontology, and this would be his own wish. Although less spectacular, his office researches also have permanent value. Among other independent publications, Granger completed revisions of the Eocene horses (1908) and condylarths (1915) that are still the standard works on these groups, and he also published important stratigraphic studies and a number of popular articles that excited wide interest. Collaboration with the late W. D. Matthew resulted in a long series of joint papers on Granger's discoveries in America and in Asia. He contributed to these not only the specimens and the field data but also a soundness of judgment and acuteness of perception that were, as Matthew frequently remarked, essential to the scientific value of the results. Granger was so modest regarding his intellectual achievements and he so firmly acquired the habit of communicating knowledge orally rather than in writing, that perhaps only those who worked with him realized the full extent of his acquaintance with vertebrate morphology and taxonomy. His interest in all such studies was keen and his untiring, unselfish assistance was endless and practical and could be acknowledged only over his protests.

He was a member of many scientific organizations, among them the Geological Society of America, Paleontological Society, Society of Vertebrate Paleontology, American Society of Mammalogists, American Ornithological Union, Linnaean Society of New York and Sigma Xi. Aside from his museum and his profession, his greatest interest was the Explorers Club, of which he was president in 1935–1937 and subsequently a director.

Dr. Granger's ashes will be privately buried in Vermont. A memorial service will be held at the American Museum of Natural History, probably late in October.

He is survived by his wife, Anna Dean Granger, formerly of Brooklyn, N. Y., to whom he was married on April 7, 1904, his companion at home and on many of his wide travels. They had no children.

It is thus possible to write a brief summary of the tangible facts of a noble career. Hundreds of hearts all over the world cherish the memory of intangibles that can not be well expressed in the midst of grief for their loss. Walter Granger had a talent for friendship and a zest for living, an inexhaustible store of affection that was returned on every side. Every one who knew him was happier because he lived.

G. G. SIMPSON
THE AMERICAN MUSEUM OF NATURAL HISTORY

DEATHS AND MEMORIALS

DR. HUGH MCCORMICK SMITH, associate curator of zoology, U. S. National Museum, died suddenly on September 28. He was seventy-five years old.

PROFESSOR ARTHUR GEORGE GREEN, formerly director of research at the British Dyestuff Corporation and professor of chemistry dyestuffs at the University of Leeds, died on September 12 at the age of seventy-seven years.

THE United States Board of Geographical Names has named one of the mountain peaks in Sequoia National Park for Dr. Gustavus A. Eisen, who died in New York on October 29 of last year. Mt. Eisen is 12,000 feet high, and is part of the Great Western Divide. Dr. Eisen was born in Stockholm in 1847 and went to California in 1873. He introduced the Smyrna fig and the alligator pear to the state. In the early '70s he made expeditions through the Sierra regions and advocated the preservation of the sequoia tree. In 1890 he was the chief instrument in establishing Sequoia National Park. He was a member of the California Academy from 1874 and served as curator from 1895 to 1900.

A PLAQUE commemorating the first collegiate course in ceramic engineering was unveiled with appropriate ceremonies at the Ohio State University on September 27. The memorial will be placed on a wall of Orton Hall, adjacent to the classroom where Edward Orton, Jr., held the first collegiate classes in that subject in 1894. Fellows of the American Ceramic Society appropriated money for the plaque, and Dr. R. R. Sosman, assistant director of the research laboratories of the U. S. Steel Corporation at Kearny, N. J., presided.

SCIENTIFIC EVENTS

THE MATHEMATICIANS OF AMERICA AND OF SOVIET RUSSIA

THE Soviet Embassy has recently received for transmission to Soviet mathematicians a statement of solidarity signed by a number of their most distinguished American colleagues.

The document carries signatures of ninety-three mathematicians of forty-seven American universities and colleges. Professor Marston Morse, president of the American Mathematical Society, and Dr. George D. Birkhoff, Perkins professor of mathematics at Harvard University, are signers, as are eight past presidents of the society.

The statement reads as follows:

We, the undersigned mathematicians of the United States, send our greetings and express our heartfelt sympathy to our colleagues of the Soviet Union in their struggle against Hitler fascism. What the future of mathematics would be in a Hitler-dominated world we know from the unprecedented destruction of mathematics in Germany after the advent of Hitler. We are deeply impressed by the heroic stand of the Soviet peoples and know that the mathematicians of the Soviet Union are doing their part in this supreme effort.

The bonds between mathematicians in the United States and the Soviet Union are particularly strong since during the past two decades the center of world mathematics has steadily shifted to these two countries. We know many of you personally and more of you through your scientific writings. We know that you are fighting alongside your fellow-countrymen in their brave struggle against the invading tyrant and we assure you that we here are doing everything in our power to aid all peoples struggling against fascism.

With best wishes for a successful fight against the evil forces of fascism, we remain, fraternally, your colleagues in the United States.

Included among the signers are the following members of the National Academy of Sciences:

Professors H. Bateman, of the California Institute of Technology; G. D. Birkhoff, of Harvard University; G. A. Bliss, of the University of Chicago; S. Lefschetz, of Princeton University; G. A. Miller, of the University of Illinois; M. Morse, of the Institute for Advanced Study; W. F. Osgood, of Harvard University; J. F. Ritt, of Columbia University; E. B. Van Vleck, of the University of Wisconsin; O. Veblen, of the Institute for Advanced Study; J. von Neumann, of the Institute for Advanced Study; J. L. Walsh, of Harvard University; N. Wiener, of the Massachusetts Institute of Technology, and E. T. Bell, of the California Institute of Technology.

NEW TYPHUS VACCINE BEING TESTED IN BOLIVIA

AMONG the problems that health authorities keep constantly in mind is that of typhus fever, which made such ravages during and after the last war. Recently a new vaccine against typhus fever was developed by Dr. Cox, Public Health Service, Hamilton, Montana, which it is hoped will be both effective and suitable for mass production. It has produced a high degree of immunity in laboratory animal tests, but in order to prove its efficiency, a trial must be made on large groups of people. Experiments could not be conducted in the United States because the form of typhus now present in this country is not the "European" type. The first attempts at testing the vaccine took place in the Balkans, Spain and China but were frustrated by the war. When the possibility of making these trials in one or more of the American republics came under consideration, it was decided to approach the matter through the Pan American Sanitary Bureau, the coordinating public health agency of the Americas. One of the chief functions of the bureau is the prevention of the international spread of disease, it being authorized by the Pan American Sanitary Code to undertake scientific research to this end. The bureau communicated with various Latin American countries in which louse-borne typhus is found and with the cooperation of the Bolivian authorities it was decided to send a commission to Bolivia to make a trial of the vaccine among 10,000 Bolivian Indians. In order to conduct the experiment, it is planned that half the members of every household, in the area chosen for the study, are to be vaccinated with typhus vaccine, to a total of 5,000 persons. The disease incidence in the vaccinated and the unvaccinated groups is then to be compared. In cases where the family refuses to have only half of its members vaccinated, it is thought desirable to inject the other half with the pneumococcus pneumonia vaccine, thus using the opportunity to conduct also a pneumonia study. Dr. R. E. Dyer, assistant director of the National Institute of Health, and his colleague, Dr. N. H. Topping, have been in La Paz, Bolivia, to work in cooperation with Bolivian authorities, who are giving their whole-hearted assistance. The experiment may require as long as nine months. It is possible that similar studies may be undertaken elsewhere should circumstances justify them.

THE WARTIME SERVICE OF BIOLOGICAL ABSTRACTS

JOHN E. FLYNN, editor-in-chief of *Biological Abstracts,* University of Pennsylvania, writes that with each month of the continuance of the war diffusion of knowledge of current scientific advances becomes more and more difficult and uncertain.

When the war broke out and the blockade was imposed, the receipt by American libraries of scientific

periodicals of Germany, Italy and the invaded nations was either delayed or completely suspended. Subsequently some of this literature began to trickle through by way of Russia, Siberia and the Pacific. The outbreak of hostilities between Germany and Russia has shut off this last important means by which European publications can reach this country. Uncertain Lisbon alone is left. The scientists of Europe are likewise handicapped by the similar unavailability of scientific periodicals published in the Americas.

The abstracting journals remain almost the only means by which scientists of different nations may remain in effective contact. *Biological Abstracts* has been undertaking to compensate, so far as an abstracting journal can compensate, for this deficiency in the means of diffusing knowledge, by arranging to abstract the European literature as completely as is possible in these times. Some of our European collaborators are still active and a considerable number of current periodicals, apparently no longer available in libraries of the United States, are regularly being abstracted. Through the cooperation of the library of the Marine Biological Laboratory at Woods Hole and of the United States Department of Agriculture, special arrangements have been made for the abstracting of the foreign periodicals obtainable in these libraries. Through the courtesy of Dr. Stephen P. Duggan, director of the Institute of International Education, the cooperation of a group of Swiss biologists has been enlisted for the abstracting of German-language periodicals available in Switzerland and not in the United States. Correspondence is actively under way with biologists in the neutral nations with the aim of locating the publications in these nations and arranging for their regular abstracting.

At the present time some 1,400 periodicals are being reviewed in *Biological Abstracts*. This includes a group of about 300 periodicals, mainly European or Latin American, assigned during the course of this special drive for the better coverage of the foreign-language literature.

The editors of *Biological Abstracts* earnestly request that all biologists who are in a position to do so will aid in the abstracting of the European literature available to them. It is only by this means that, for the duration of the war, current research in biology can be brought effectively to attention. Any who are not now assisting in this way but are willing to do so are asked to communicate with Dr. Flynn.

CENSUS OF SCIENTIFIC AND SPECIALIZED WORKERS IN THE UNITED STATES AND IN OTHER COUNTRIES

IN connection with the development of the National Roster of Scientific and Specialized Personnel, President Leonard Carmichael and Robert Shosteck report that it has become important to have for comparative purposes some statistical information concerning specialized personnel in countries other than the United States. From a number of points of view connected with national defense and cultural relations this information seems to be important. It will also be useful in demonstrating to American authorities the relationship between numbers of specialists and the effective defense level of various nations. Possibilities of international collaboration in the sciences may also first be determined in certain instances from such a table.

It has proved surprisingly difficult to secure information of this sort. Varied sources have been tapped to secure the incomplete data now in the Roster's file. These sources include censuses, professional directories and registries, yearbooks of various nations, professional society memberships as given in *Minerva*, and data secured by American diplomatic representatives in various nations. It is likewise recognized that some of this information may be inaccurate or somewhat out-of-date, as well as incomplete.

The data which have been compiled are available to readers of SCIENCE, who may obtain copies of the mimeographed report by application to the National Roster of Scientific and Specialized Personnel, Atlantic Building, Washington, D. C.

The authors will be grateful to readers of SCIENCE who may be in a position to amplify, correct or otherwise make suggestions concerning the preliminary tabulations contained in this report. Indications concerning the number of members in professional societies, persons registered in various professional or scientific fields, or other census figures for any particular country or professional occupation, would be acceptable. Possibly some readers may be willing to consult displaced foreign workers now in this country who may have information concerning this matter. All information in this field should be addressed to the authors at the address given above.

It must again be emphasized that the figures presented in the National Roster's tabulation are offered merely as a starting point for future corrections and additions. The data are arranged by fields for each country, and the source of all data is given on a supplementary sheet.

RETIREMENTS AT THE OHIO STATE UNIVERSITY

AT the Ohio State University the following members of the faculty have retired with the title emeritus: Dean J. H. J. Upham, of the College of Medicine; Dr. William Lloyd Evans, chairman of the department of chemistry, and Dr. Joseph A. Leighton, chairman of the department of philosophy.

In appreciation of their work the Board of Trustees of the university passed the following resolutions:

Of Dr. Upham: Devoted to the maintenance and upbuilding of high standards in medical education and practice, his constructive career has won local, state and nation-wide recognition, as attested by his appointment to the deanship, by his former presidency of the Columbus Academy of Medicine, the Ohio State Medical Association and the American Medical Association; by his presidency-elect of the Ohio Public Health Association, and by his service as a member of the Ohio State Medical Board and of the National Board of Medical Examiners.

Of Dr. Evans: Beloved by students through the years as a teacher, effective, sympathetic and of contagious enthusiasm, esteemed by his faculty colleagues as one indispensable to the life and work of the university. Professor Evans likewise shares eminence with the most distinguished research chemists of the nation. Awarded the coveted Nichols Medal of the American Chemical Society in 1929, his intensive investigations, especially in the field of the carbohydrates, have won notable commendation. His present service in the presidency of the American Chemical Society attests to leadership in his profession and signalizes a career of unusual productivity.

Of Dr. Leighton: Schooled in the classics, religion and philosophy, Dr. Leighton has occupied no ivory tower of recondite reflection, but has concerned himself energetically with the problems of the social order—bringing to the study of these problems, as a lecturer and teacher widely sought and as a writer widely read, the rich resources of scholarly competence and of penetrating philosophical interpretation. Dr. Leighton is a past president of the American Philosophical Association.

SCIENTIFIC NOTES AND NEWS

DR. LUDVIG HEKTOEN, professor emeritus of pathology at the Rush Medical College and the University of Chicago, executive director of the National Advisory Cancer Council, received a citation on September 10 from the State Medical Society of Wisconsin during its annual session. This is the society's centennial award for distinguished service. The presentation was made at the annual banquet by Dr. Stephen E. Gavin, chairman of the council of the society. Dr. Hektoen was director of the John McCormick Institute for Infectious Diseases, Chicago, from 1901 to 1940.

HAVING reached the age of sixty-five years, Dr. Fred C. Koch, Frank P. Hixon distinguished service professor and chairman of the department of biochemistry of the University of Chicago, and Dr. Gilbert A. Bliss, Martin A. Ryerson distinguished service professor and chairman of the department of mathematics, retired with the title emeritus on October 1.

THE following have been appointed visiting professors at the School of Tropical Medicine at Puerto Rico: Colonel Alexander T. Cooper, U. S. A. Medical Corps, retired, military medicine; Dr. C. A. Wright, the U. S. Public Health Service, sanitary science; Dr. J. O. Dean, the U. S. Public Health Service, public health practice; Dr. David B. Dill, professor of industrial physiology, Harvard University, physiology; Dr. James A. Doull, professor of hygiene and public health, the Medical School of Western Reserve University, epidemiology; Dr. Thomas H. D. Griffitts, the U. S. Public Health Service, public health; Dr. William B. Porter, chief of medical service, the Medical College of Virginia, medicine, and Dr. William H. Taliaferro, dean of the division of the biological sciences, the University of Chicago, protozoology.

DR. WILLIAM CARSON VON GLAHN, associate professor of pathology at the College of Physicians and Surgeons of Columbia University, has been appointed professor of pathology at the College of Medicine of New York University, and has been made head of the department of pathology and laboratories at Bellevue Hospital. An agreement worked out between the city and New York University gives the university the privilege of nominating all members of the department of pathology of Bellevue Hospital and of the laboratory staff.

THE *Journal* of the American Medical Association states that Dr. Adolph Weinzirl, health officer of Portland, Ore., has been appointed director of the social hygiene fund and of a new department of public health at the Medical School of the University of Oregon, established recently by the will of the late Dr. Ellis C. Brown. Under its terms the director will spend a third of his time teaching in the university and the remainder in educational work throughout the state.

DR. FRANK D. BLOHM, of the Bangs Testing Laboratory of the Bureau of Animal Industry, has been appointed assistant professor of veterinary pathology at the Iowa State College.

GEORGE D. THORNTON, formerly assistant agronomist at the Georgia Agricultural Experiment Station, has been appointed assistant professor of soils and assistant soil microbiologist at the University of Florida. Dr. Lewis Rogers has returned to the university as associate soil biochemist after spending a year at Cornell University, where he completed the work for the doctorate in chemistry.

DR. LANCELOT HOGBEN, Regius professor of natural

history in the University of Aberdeen, has been appointed Mason professor of zoology in the University of Birmingham. He succeeds Professor H. Munro Fox.

THE Anheuser-Busch Company, St. Louis, has given to the College of Medicine of the University of Cincinnati a grant of $30,000, in addition to $15,000 previously given, for the promotion of research on the part played in human nutrition by the constituents of yeast. The work is carried on under the direction of Dr. Tom D. Spies, under the department of internal medicine.

AFTER more than forty-two years of service in the U. S. Department of Agriculture, Edgar Brown, principal botanist of the Bureau of Plant Industry, retired from active duty on September 30. He plans to continue his research as a collaborator.

AT the opening exercises of the eighty-third academic year of the Long Island College of Medicine, the resignation for reasons of health of Dr. Frank L. Babbott, formerly professor of pediatrics, from the office of president was announced by Henry A. Ingraham, chairman of the Board of Trustees. Dr. Babbott has accepted one of the vice-chairmanships of the College Board of Trustees and the chairmanship of the Committee on Education. Dr. Jean A. Curran, dean of the college, will continue as acting president.

DR. EDWIN H. COLPITTS, until his retirement in 1937 as vice-president of the Bell Telephone Laboratories, has become director of the Engineering Foundation to succeed the late Dr. Otis Ellis Hovey. Established in 1914 by a gift of the late Dr. Ambrose Swasey, the purpose of the Engineering Foundation is "the furtherance of research in science and engineering and the advancement in any other manner of the profession of engineering and the good of mankind."

CHARLES B. HEMMING, for fifteen years research and development chemist with E. I. du Pont de Nemours and Company, has been appointed chief chemist of the United States Plywood Corporation. He will supervise the expansion and coordination of the company's research facilities in plants throughout the country.

RICHARD O. EDGERTON, research associate at the Massachusetts Institute of Technology, has become research chemist in the Ciné Processing Department of the Eastman Kodak Company, Rochester, N. Y.

ELMORE S. PETTYJOHN, associate professor of chemical engineering of the University of Michigan, has been granted leave of absence to answer a call to active sea duty in his capacity as Lieutenant-Commander in the United States Navy. Dr. Robley C. Williams, assistant professor of astronomy, has leave for the first semester in order that he may join the research staff of the Department of Terrestrial Magnetism in Washington to work on a defense problem.

DR. JOHN H. YOE, professor of chemistry, University of Virginia, has been commissioned a colonel in the Tennessee National Guard and aide-de-camp on the governor's staff.

BRYANT MATHER, assistant curator of mineralogy at the Field Museum of Natural History, is on leave of absence on an emergency civilian appointment under the Corps of Engineers of the U. S. Army. He will work at the Concrete Laboratory, West Point, N. Y.

MISS ALICE L. DUSTAN, formerly assistant garden editor of *The New York Times,* has become station editor at the Agricultural Experiment Station at New Haven. She will take the place of Miss K. Palmer, who has held the post at New Haven for the past seven years.

THE Registry of Dental and Oral Pathology at the U. S. Army Medical Museum has formed a circulating committee of consultants to which the more interesting and difficult cases will be sent for an opinion. The following men have been asked, and have agreed to act as consultants: Kurt H. Thoma, Harvard University; Balint Orban, Chicago College of Dental Surgery; Lester R. Cahn, Columbia University, and Hamilton B. G. Robinson, Washington University, St. Louis.

DR. WILLIAM E. LADD, professor of surgery in the Harvard Medical School, delivered on October 3 the thirteenth annual Arthur Dean Bevan Lecture of the Chicago Surgical Society at the forty-first annual dinner of the society at the University Club of Chicago. His subject was "Children's Surgery and Its Relation to the Specialties." The William E. Ladd professorship of surgery was endowed this year by a group of friends in recognition of Professor Ladd's contributions to the field of surgery for children.

DR. WALTER P. KELLEY, head of the Division of Soils of the University of California, gave two lectures at the Iowa State College on September 29. He spoke on "Soil Colloids in Relation to Agriculture" and on "The Essential Nature of the Clay Minerals and Their Relation to Soils."

MEETINGS of the American Physical Society are scheduled as follows: December 19–20, Pacific Coast meeting, Stanford University, California; December 29–31, annual meeting, Princeton; February 20–21, Detroit; April, time and place to be designated; June, Pacific Coast, time and place to be designated, and June, State College, Pennsylvania.

THE New England Conference of the American

Association of Museums will meet at Newport, R. I., on October 16, 17 and 18.

THE first of a series of meetings sponsored during the 1941–42 academic year by the New York branch of the American Association of Scientific Workers will be devoted to the subject of "Science and Civil Liberties." The speakers will be Dr. William M. Malisoff, professor of biochemistry of the Brooklyn Polytechnic Institute, and Dr. Lewis Balamuth, instructor in physics at the College of the City of New York. The meeting will be held on October 15, at 8:15 P.M., in John Jay Hall, Columbia University.

THE School of Mathematics of the Institute for Advanced Study each year allocates a small number of stipends to gifted young mathematicians and mathematical physicists to enable them to study and to do research work at Princeton. Candidates must have given evidence of ability in research comparable at least with that expected for the degree of doctor of philosophy. Blanks for application may be obtained from the School of Mathematics of the Institute, Fuld Hall, Princeton, N. J., and are returnable by February 1, 1942.

APPLICATIONS for Benjamin Peirce instructorships at Harvard University for the academic year, 1942–43, should be sent to the chairman of the department of mathematics. Candidates should have received the Ph.D. degree or have had equivalent training.

IN accordance with a Basic Science Law passed by the Legislature of the State of New Mexico in April, 1941, the State Board of Examiners in the Basic Sciences has been established, with the following personnel: *President of the Board,* Dr. John D. Clark, professor of chemistry, University of New Mexico; *Vice-president,* Dr. Fred W. Allen, New Mexico Industrial School, Springer; *Members Secretary,* Pia Marie Joerger, Office of the Secretary of State, Santa Fe; L. M. Pearsall, an osteopathic practitioner, Albuquerque; Dr. P. L. Travers, a physician and surgeon, Santa Fe; Wm. K. Wootton, a chiropractic practitioner, Albuquerque. The newly established board is to give examinations in the basic sciences on October 12, 1941, at the University of New Mexico, and thereafter each second Monday in June and each first Monday in February.

ACCORDING to *The Experiment Station Record,* the Legislature has appropriated $2,412,900 for the support of Kansas College and the four branch stations during the current biennium. In addition to lump sum appropriations for salaries and maintenance of instruction and research, $120,000 is appropriated for the branch stations, $53,000 for outlying experiment fields, $10,000 for bindweed experimental work, $30,000 for research work on diseases of livestock, $15,000 for milling and baking research, $30,000 for laboratory equipment, $15,000 for the purchase and improvement of horticultural land, $10,000 for repairs and improvements to the physical plant of the department of animal husbandry, $50,000 for the construction of a small animal research laboratory, $8,000 for the purchase of land at the Colby Substation and $200,000 for extension work. Other new items include $30,000 for three home management houses, $19,500 as indemnity for the fire losses of March 15 and $30,000 for a WPA project for a military science building to cost $125,000. Other legislation affecting the institution included a quarter-mill tax levy which is expected to raise $600,000 per year for a building program at the five state schools, specific allocations from this fund to be made by future legislatures; an act authorizing the state schools to construct student union buildings and dormitories under a plan for ultimate repayment from fees and operating revenues, and a civil-service law covering certain non-teaching, non-research and non-administrative positions in the state schools.

THE new ligature plant of the Johnson and Johnson Company in North Brunswick, N. J., was dedicated on September 25. The new building is air-conditioned. The exterior is of Vermont marble and stainless steel, relieved by a narrow strip of plate glass skirting the sides without the usual framing. Two thirds of the space is for the processing of ligatures and there is a second building within the main building to be used for the sterilization and hermetical sealing of the processed materials.

DISCUSSION

THE VERTICAL DISTRIBUTION OF HEAVY MINERALS IN VIRGIN AND CULTIVATED SOILS

THE primary soil minerals may be divided into two broad groups. The first includes the so-called light minerals (specific gravity < 2.680), chief among which are quartz, orthoclase, albite and oligoclase. The second group includes the so-called heavy minerals (specific gravity > 2.680) of which labradorite, anorthite, augite, hornblende, muscovite, biotite and apatite may be mentioned. Minerals in the first group usually weather more slowly than those in the second group.

It has been observed frequently that the content of heavy mineral in podzol and gray-brown podzolic forest soils increases with increasing depth below the

surface. The relatively low content of heavy minerals in the A horizon of soils belonging to the above zonal groups reflects the intensity of weathering to which they have been exposed.

Previous work by the writer[1] demonstrated that the content of heavy minerals in the upper part of forest soil bodies disturbed by the uprooting of trees was significantly higher than in adjacent undisturbed soil. This difference resulted from the translocation of material from the B or C horizons to the surface. The possibility that cultivation might similarly influence the vertical distribution of heavy minerals in soil profiles was considered.

During the summer of 1940 samples from unquestionably virgin soils and immediately adjacent cultivated soils were collected in Michigan and New Hampshire for laboratory examination. In all instances the sets of paired samples were collected from soils which seemingly differed only with respect to the cultivation factor. Miami, Colton and Hermon soil series were represented.

It has been found that the cultivated soils contain a consistently higher percentage of heavy minerals in the A horizon than do the comparable virgin soils. The results indicate that the vertical distribution of heavy minerals in the upper horizons of soil profiles may serve as an index of past agricultural use of land. This criterion may prove useful in studies concerned with the past history of land utilization. Work on the vertical distribution of heavy minerals in soil profiles is being continued and more detailed results will be published in the near future.

H. J. LUTZ

YALE UNIVERSITY

REPORTING DATA ON ELECTRIC MOBILITY

RECENT interest in the electrophoresis of proteins has led to the publication of a large number of papers giving data on the speed with which proteins migrate in an electric field. Because the serum proteins near their isoelectric points move rather slowly, certain investigators expressed the electric mobilities in units of 1×10^{-5} cm/sec/volt/cm. However, other investigators studying ionic mobilities and the electric mobilities of microscopically visible particles have for many years expressed the electric mobilities in units of 1×10^{-4} cm/sec/volt/cm or its equivalent in μ/sec/volt/cm. There does not seem to be any justification for the use of the exceptionally low mobilities of proteins near their isoelectric points as convenient reference mobilities. In view of confusion which has arisen, it would be well for the conventional unit of 1×10^{-4} cm or μ/sec to be generally adopted by those in the field of electrophoresis. This will serve to eliminate a good deal of future error of the type which has already arisen.

HAROLD A. ABRAMSON

DEPARTMENT OF PHYSIOLOGY,
COLLEGE OF PHYSICIANS AND SURGEONS,
COLUMBIA UNIVERSITY

ANTIDOTING TOXIN OF PHYTOPHTHORA CACTORUM AS A MEANS OF PLANT DISEASE CONTROL[1]

OVER forty years ago phytopathologists realized that certain fungi formed toxins which were lethal to plant protoplasm and which paved the way for the advance of the pathogenic organism through the plant tissues. *Phytophthora cactorum,* which causes a wilt disease of many plants and the bleeding canker of hardwood trees, produces such a toxin when grown on various media. Foliated, succulent excised maple and tomato shoots wilt when placed in filtrates of liquid media upon which the fungus has grown.

This toxic effect can be antidoted, that is, made inactive by the addition to the filtrate of 0.5 per cent. aqueous solution of the di-hydro-chloride salt of di-amino-azo-benzene plus a solvent and penetrant ("Helione orange"). Healthy maple trees injected with the toxic filtrate have been killed, while the same toxic filtrate to which 0.5 per cent. of the di-amino-azo-benzene salt was added failed to injure the trees.

In excess of 350 confirmed trees, naturally infected by the bleeding canker fungus, have been injected with the antidoting chemical, and have subsequently exhibited stoppage of "bleeding" and marked improvement in vegetative growth. Whether the trees have been "cured" in any absolute sense remains to be seen, but the results indicate some possibilities to be explored in the practical control of plant disease.

FRANK L. HOWARD

RHODE ISLAND STATE COLLEGE

THE FIRST MATHEMATICS SECTION OF THE NATIONAL ACADEMY OF SCIENCES

MATHEMATICAL research in the United States was started at about the time that the National Academy of Sciences was incorporated (1863) and the first important mathematical research paper published in our country was written by Benjamin Peirce who was one of the earliest members of this academy and took an active part in its early meetings. It is therefore of interest to consider briefly the qualifications of the members of the first mathematics section of this academy. Their names are J. G. Barnard, William Chauvenet, H. A. Newton, Benjamin Peirce, Theo-

[1] Harold J. Lutz, *Yale University: School of Forestry, Bulletin 45.* 1940.

[1] Contribution No. 599 of the Rhode Island Agricultural Experiment Station.

dore Strong and Joseph Winlock. In the year 1925 the Mathematical Association of America established a prize for the best expository paper published in English during successive periods, which is now awarded every three years and is called "The Chauvenet Prize."

The name of Chauvenet is therefore also now well known to the mathematical public of our country as an important contributor to the advancement of their subject, especially along the line of clear exposition. The remaining four names of the first mathematics section of the National Academy of Sciences are probably now less widely known among American mathematicians but they also became known internationally as results from the fact that a number of the publications of each of them are noted in the widely used periodical called *Poggendorff's Handwörterbuch*. This was started in the same year as the National Academy of Sciences and is still being continued with increasing completeness as regards advances in science in the different countries of the world.

It is interesting to note that the later developments have proved that the National Academy of Sciences selected its first mathematical members with reasonable wisdom since the merits along this line are unusually difficult to judge by those working in other scientific fields. While this Academy has served from its beginning as an adviser of the national government along scientific lines it has wisely aimed also to encourage scientific work of high order throughout the nation by maintaining high standards for membership. By the election of a small number of "Foreign Associates" it has aimed to extend its influence beyond the borders of our own land and by including W. R. Hamilton and Michel Chasles in the first list of ten it has also exhibited wisdom along the line of mathematics in these selections.

Recently J. L. Coolidge of Harvard University published "A History of Geometric Methods" which was explicitly inspired by a work of Michel Chasles published a little over one hundred years ago (1837) but which is still widely used. This shows that some writings on the history of mathematics have been useful during a long period of time notwithstanding the fact that many more recent ones were so written that they were very soon regarded as out of date. Recently the Royal Irish Academy began the publication of the mathematical papers of W. R. Hamilton. The first volume appeared in 1931 and the second in 1940. Hence the early members of the National Academy of Sciences also made wise selections as regards the mathematical "Foreign Associates" in view of the enduring value of their works.

G. A. MILLER

UNIVERSITY OF ILLINOIS

SCIENTIFIC BOOKS

INFECTIOUS DISEASE

Biological Aspects of Infectious Disease. By F. M. BURNET, M.D., assistant director, Walter and Eliza Hall Institute, Melbourne. x + 310 pp. Illustrated. New York: The Macmillan Company; Cambridge, England: At the University Press, 1940. $3.75.

THE dawn of bacteriology was not interested to answer the question: In what manner have the human race and the Animal Kingdom become subject to the multiform epidemization so vividly experienced in the mass mortalities during the centuries preceding the discovery of bacteria? An elucidation of the nature of the infections prevailing at that time promised results of great practical and theoretical significance. To view an infection from the standpoint of the naturalist as analogous to or identical with the biological phenomena of parasitism is an achievement of recent years. By taking an anthropocentric attitude, the student of human disease, a human being himself and trained solely in medical bacteriology, conceived the infection as a struggle between man and microbe being waged with special weapons. In the foreground of his study was placed the altered state of the host—the disease. With the recognition of the so-called latent infections and the infections without an infectious disease, this strictly utilitarian concept was found untenable. With the realization that an infection may be studied with advantage as a branch of academic biology, it was likewise appreciated that it may be analyzed along ecological lines as a struggle for existence between man and microorganisms of the same general character as the competition between plant or animal species in nature. Those who by necessity were forced to interpret the dangers of infections, which emanate from the vast reservoir in the Animal Kingdom, fully acknowledge the guiding hand in the ecological concept of the epidemics induced by the population regulators—the microbian or virus parasites. Humble attempts to focus attention on both man and animal and on the microorganism as objects of equal interest have been made by a few authors in special monographs, but it is to the great credit of Burnet to present the teacher and, in particular, the student with a remarkable example of scientific writing and an invaluable summary on the biological aspect of infectious disease.

In 6 parts, subdivided into 15 chapters and dili-

gently, but with rare discrimination, compressed into 308 pages, the reader will find a classical condensation of every important fact and principle gathered during the past 60 years by the sciences of bacteriology, physiology, immunochemistry, epidemiology and public health. Whenever it appeared necessary, carefully selected impressive examples of disease states or epidemics are chosen to illustrate the microorganisms and their way of infection or the processes which govern their action. Every sentence incorporates one or several facts, and may on ultimate analysis review years of research and the final conclusions derived from many publications. Needless to emphasize, such a book requires slow and attentive reading in order that one may derive all the benefits of the review. Although intended to be "interesting to the layman with a taste for science," it must be admitted that even the seasoned expert and teacher will find the presentation stimulating to his memory and challenging to his intellect.

Under the heading of the "evolution of infection and defence," the genesis of parasitism is traced from the amoeba ascending to the highly developed man as a progressively increased ability to accept parasites. The elementary interaction between parasite and cell remains deeply impressed on the evolution of the defense reactions. To-day nobody will doubt the facts recognized by Metchnikoff that the phagocytic cells of the blood and of the fixed tissues *are* the defenders of the body. In Part II the author designates the bacteria, protozoa and viruses as the "aggressors." Perhaps it is unfortunate that this term was chosen, since it conveys the impression of a struggle between the parasite and the host being waged by special weapons —the "aggressins" of Bail. In reality it is not the power to induce disease, the so-called "pathogenicity," but the ability of the parasite to settle and to grow in living tissues, which is of biologic interest and worth detailed research. As a thorough student and pioneer in the realm of viruses, Burnet is well qualified to dissect these important enemies of life, and the methodology elaborated for their study. Concerning the biological position of viruses, he apparently favors the hypothesis that they are "the diminished descendants of pathogenic bacteria."

In Part III following a discussion of the fundamental physiologic activities of the blood and blood vessels as a part of the defenses against bacterial infections, the "wider significance of immunity," the function and the formation of antibodies," the "species disposition" and "what makes bacteria dangerous" receives detailed consideration. According to the author, the substance which controls the permeability of the capillaries is histamine. In the light of Menkin's studies, the nitrogenous compounds responsible for these reactions exhibit significant properties which do not resemble those of histamine. The recovery from pneumonia, the nature and function of antibodies, and the interrelation of toxin and antitoxin, as viewed by the immunochemists, are intriguing summaries and examples of fine scientific writing. One wonders what Burnet means when he says:

> If in this immune reaction we have a means of transferring "reminders" to other cells, and so modifying their behavior appropriately without their having had direct experience of the appropriate stimulus, it becomes somewhat less fantastic to think that perhaps after all the sequences of altered habit, improved function and structural modification may in the long run convey some appropriate "reminder" to the reproductive cells and incorporate the change into the inheritable constitution of the species.

Acquired immunity alters the susceptibility but, as for example, in measles the descendants of resistant parents have shown for centuries a remarkably stable susceptibility and reactibility to the virus. Thus the immunity is not inherited, but the potentiality of acquiring immunity or the efficiency of the immunity mechanism is apparently dependent on constitutional factors. Concerning the harmful effects of bacteria, Burnet is not specific relative to the terminology as to what constitutes virulence and what is invasiveness. The latter depends on the surface structure of the bacteria, while the former is rather an intangible quantity which is difficult to measure. The capacity to produce a generalized deleterious effect or the so-called virulence depends on diverse poorly understood genotypic and phenotypic factors, that bacteriologists have in recent years hesitated to use the term.

The natural history of infectious disease, the "why epidemics," "how infections spread," reviewed in Part IV, considers the infection chains, the animal reservoirs, the cause of epidemic and endemic distributions, the age-incidence of disease, immunity as an epidemiological factor and the general principles of control. Part V is principally devoted to a detailed discussion of the important infectious diseases: diphtheria, influenza, tuberculosis, plague, cholera, malaria and yellow fever. The big three: influenza, plague and cholera, are treated from a historical point of view, and the latest scientific data are well analyzed. Despite the existence of different antigenic types of the influenza, Burnet hints that it might be possible to obtain "master strains" with antigenic pattern which would immunize against any but the wholly new types, such as the 1918 pandemic strain. In regard to tuberculosis, attention is called to the fact that with the isolation of patients and the diminution of frank cases an in-

creasingly large number of people will reach adult life without exposure to a tubercle bacillus infection; some sort of vaccination may have to replace the "normal childhood infection."

In a thoughtful epilogue, one is again reminded of the well-known fact that "wars, internal and external, financial depressions and labor troubles are all breeders of infectious disease. Who knows, a serious world-wide epidemic might perhaps do more to initiate a sense of genuine international cooperation." Artificial dissemination of disease as a war measure is likely to be unsuccessful, but such a weapon could be created. To combat it, Burnet believes "would require a wholly new social technique, which would bring to light as leaders men of entirely different instinctive qualities from those who now stand in authority."

This book in its handy and convenient form and with its vast store of material carefully and attractively presented is highly recommended to everybody, but in particular to all students in medicine and biology.

K. F. MEYER

GEORGE WILLIAMS HOOPER FOUNDATION,
UNIVERSITY OF CALIFORNIA,
SAN FRANCISCO

SPECIAL ARTICLES

THE EFFECT OF 17-HYDROXYCORTICOSTERONE AND RELATED ADRENAL CORTICAL STEROIDS ON SODIUM AND CHLORIDE EXCRETION[1]

RECENT studies[2] suggested that adrenal cortical steroids with a hydroxyl group on C_{17} induced an increased excretion of sodium and chloride in contrast to the well-known sodium and chloride "retaining-effect" of other adrenal steroids such as corticosterone and desoxycorticosterone.[3] For this reason a comparison has been made of the effect of a number of adrenal cortical steroids on the renal excretion of sodium and chloride in an effort to determine, if possible, the relationship of chemical structure to physiological activity. The experimental methods which have been used are similar to those which have been reported previously.[3]

The subcutaneous injection of 5 and 8 mg respectively of 17-hydroxycorticosterone was followed by a significant increase in the renal excretion of sodium and chloride in a normal dog (Table 1). 1 mg of this substance was ineffective in this respect. The injection of 25 mg of 11-dehydro-17-hydroxycorticosterone was followed by a striking increase in sodium and chloride excretion in both a normal dog and an adrenalectomized dog maintained on a low sodium chloride intake. In the normal dog, sodium excretion increased from a level of 10 m.eq. per day prior to treatment to 25 m.eq. on the day of therapy. In the adrenalectomized dog sodium excretion increased from a level of 10 m.eq. per day prior to treatment to 48 m.eq. on the day of therapy. In both instances chloride excretion paralleled the changes in sodium excretion. In normal rats the injection of 6 mg of 11-dehydro-17-hydroxycorticosterone increased the 24-hour excretion of sodium chloride by approximately 75 per cent. during the day of therapy. Potassium, nitrogen and inorganic phosphorus excretion were increased appreciably during treatment with either 17-hydroxycorticosterone or 11-dehydro-17-hydroxycorticosterone in normal and adrenalectomized dogs and rats. The relation of these changes to changes in carbohydrate metabolism have been considered.[1]

In contrast to the effect of these two compounds, treatment with desoxycorticosterone or corticosterone was followed by a significant retention of sodium and chloride (Table 1). Allopregnane-3,11,17,20,21-pentol and allopregnane-3,17,20-triol were found to be inactive. When 11-desoxy-17-hydroxycorticosterone is available for experimental use it will be possible to determine the physiological effect of the hydroxy group on C_{17} in the absence of an oxygen atom on C_{11}. The relation of chemical structure to physiological activity is illustrated in Fig. 1.

TABLE 1

THE EFFECT OF ADRENAL CORTICAL STEROIDS ON THE RENAL EXCRETION OF SODIUM AND CHLORIDE IN NORMAL DOGS

24-hour period	Urine volume cc	Sodium m.eq.	Chloride m.eq.	Substance	Quantity mg
Control	480	56	53		
Treated	640	71	67	17-Hydroxycorticosterone	5
Control	500	50	50		
Treated	600	69	62	17-Hydroxycorticosterone	8
Control	450	54	55		
Treated	520	46	49	Corticosterone	4
Control	470	56	56		
Treated	420	29	38	Desoxycorticosterone	1
Control	530	57	59		
Treated	480	56	57	Allopregnane-3,17,20-triol	5
Control	650	57	61		
Treated	640	58	61	Allopregnane-3,11,17,20,21-pentol	5

[1] This study was aided by a grant from the Committee on Research in Endocrinology, National Research Council.

[2] G. W. Thorn, R. A. Lewis, G. F. Koepf and S. S. Dorrance, *Trans. Assoc. Am. Phys.*, 56: 1941 (in press).

[3] G. W. Thorn, L. L. Engel and H. Eisenberg, *Jour. Exper. Med.*, 68: 161, 1938.

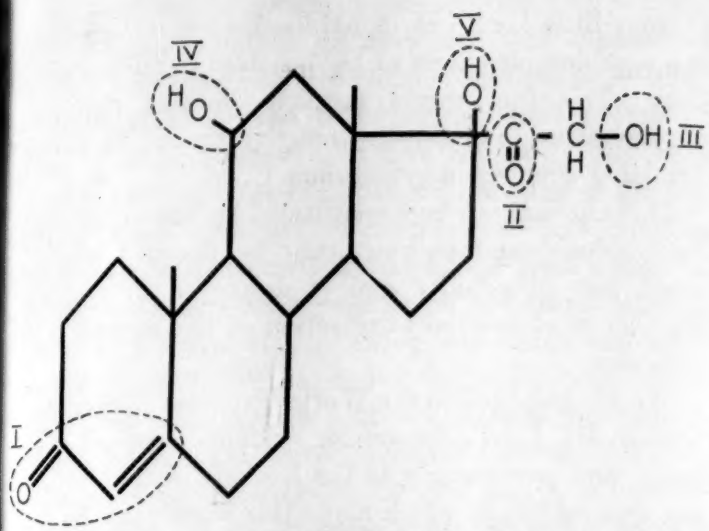

FIG. 1. I. Is essential for all known physiological activity. II. Is essential for all known physiological activity. III. Enhances sodium retention; necessary for carbohydrate activity. IV. (Either a hydroxyl or a carbonyl group.) In the presence of III, decreases sodium retention and increases carbohydrate activity. V. In the presence of III, and ? IV, increases carbohydrate activity and induces sodium excretion.

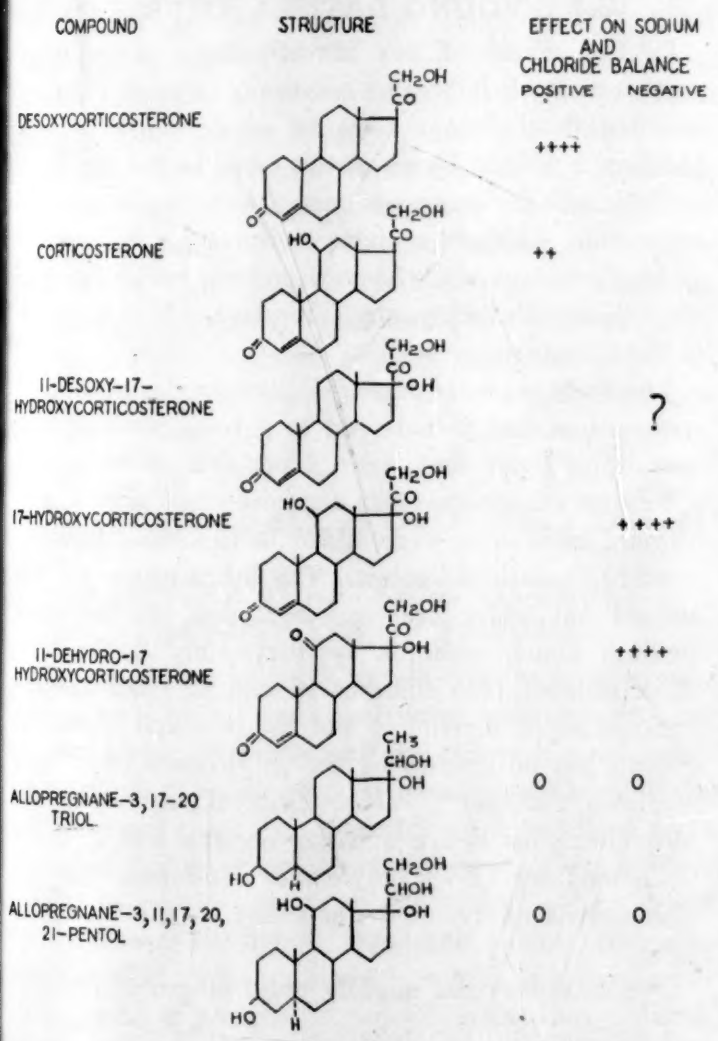

FIG. 2

These studies help to clarify a number of controversial experimental data in regard to the effect of various cortical extracts and their derivatives on electrolyte metabolism. It is also apparent from this study why desoxycorticosterone acetate therapy, (sodium-retaining factor) in Addison's disease produces edema so readily in contrast to treatment with adequate doses of potent adrenal cortical extract which contains a mixture of "sodium-retaining" and "sodium-excreting" factors.

We are indebted to Dr. E. C. Kendall, of the Mayo Clinic, Rochester, Minnesota, and Professor T. Reichstein, of Basel, Switzerland, for the crystalline compounds used in this study.

GEORGE W. THORN
LEWIS L. ENGEL
ROGER A. LEWIS[4]

CHEMICAL DIVISION, MEDICAL CLINIC,
THE JOHNS HOPKINS UNIVERSITY
AND HOSPITAL

THE ENZYMATIC LINK BETWEEN DIHYDRO-DIPHOSPHOPYRIDINE NUCLEOTIDE AND CYTOCHROME C

ALTHOUGH it has been generally held that reactions involving diphosphopyridine nucleotide (DPN) are linked to oxygen through cytochrome C, no isolated enzyme system has as yet been shown to catalyze the reduction of cytochrome C by reduced DPN ($DPN \cdot H_2$). Corran, Green and Straub[1] have suggested that heart flavoprotein performs this function, but no evidence has been presented on which such a suggestion can be based. Lockhart and Potter[2] demonstrated the existence in crude heart muscle extract of such an enzyme system, but the active agent was apparently not capable of being extracted in a soluble form and therefore could not be subjected to fractionation and purification. In this note we are reporting the extraction from baker's yeast of a soluble enzyme which is very active in catalyzing the reduction of cytochrome C by $DPN \cdot H_2$.

A spectrophotometric test similar to that used by Haas, Horecker and Hogness[3] in the isolation of cytochrome reductase was used. The DPN was reduced by a system consisting of hexose disphosphate, arsenate and an acetone dried enzyme powder containing zymohexase, isomerase and phosphoglyceraldehyde oxidase prepared according to the method of Warburg and Christian.[4] The DPN is incubated with this mixture for one-half hour at 25° and then heated for five minutes to 85° to destroy all the enzymes present. The $DPN \cdot H_2$ is unaffected by this heating process and is stable for several days. Upon mixing an excess of $DPN \cdot H_2$ and cytochrome C in an absorption cell,

[4] John D. Archbold Fellow-in-Medicine.

[1] H. S. Corran, D. E. Green and F. B. Straub, *Biochem. Jour.*, 33: 793, 1939.

[2] E. E. Lockhart and V. R. Potter, *Jour. Biol. Chem.*, 137: 1, 1941.

[3] E. Haas, B. L. Horecker and T. R. Hogness, *Jour. Biol. Chem.*, 136: 747, 1940.

[4] O. Warburg and W. Christian, *Biochem. Zeits.*, 303: 40, 1939.

no change in the extinction at 550 mμ (α band of reduced cytochrome C) is observed. However, when 35 γ of a partially purified enzyme preparation is added, the cytochrome C is rapidly reduced, the color of the solution changes from brown to pink, and the extinction at 550 mμ is increased. The rate of the reaction is apparently first order with respect to cytochrome C concentration, proportional to the enzyme concentration, and independent of small variations in the concentration of DPN · H_2.

In Fig. 1 is shown the effect of DPN · H_2 on the rate

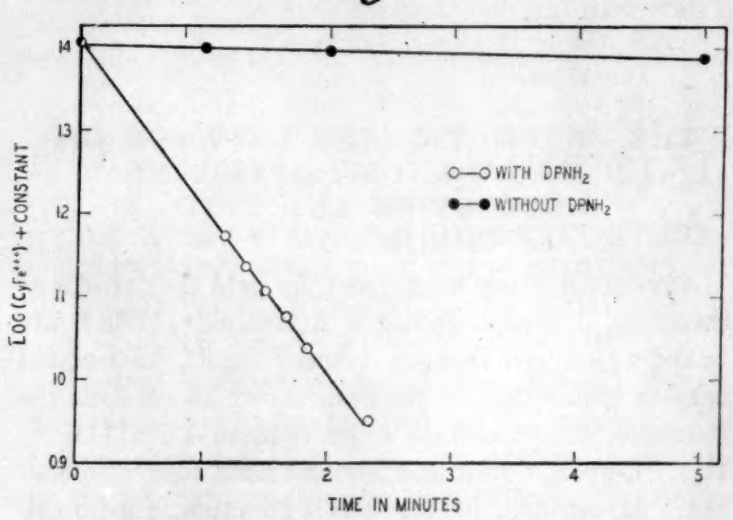

FIG. 1. Enzymatic reduction of Cytochrome C, with and without DPN · H_2.

of reduction of cytochrome C by a dialyzed and somewhat purified enzyme preparation. The slopes of the straight lines shown in the drawing are directly proportional to the rate of the reduction. When DPN · H_2 is added to the test solution, 5×10^{-7} moles of cytochrome C are reduced per minute per cc of enzyme solution used. In the absence of DPN · H_2, the rate of reduction is reduced to 1 per cent. of the above rate.

The activity of this enzyme can also be observed by measuring the change in absorption at 340 mμ (position of absorption band of DPN · H_2). When DPN · H_2 is oxidized, the light absorption at this wavelength is decreased. The results of a series of experiments are shown in Table 1.

TABLE I

Experiment	cc DPN·H_2 (10^{-6} moles/cc)	cc DPN (2.5×10^{-6} moles/cc)	cc Cytochrome C (1.5×10^{-6} moles/cc)	cc Enzyme (20 mg./cc)	Δ*
1	0.20	...	0.05	0.05	0.212
2	0.20	...	...	0.05	0.025
3	...	0.05	0.05	0.05	0
4	0.20	...	0.05	...	0

* Δ is the decrease in log $\frac{I_0}{I}$ at 340 mμ, upon addition of enzyme. A 0.5 cm absorption cell was used. $\frac{M}{40}$ phosphate buffer, pH = 7, was used to bring volume to 1.25 cc.

It is to be noted that in the absence of cytochrome C, very little DPN · H_2 is oxidized, even though there is a considerable excess of O_2 dissolved in the test solution. This fact would seem to indicate that this enzyme solution is far less reactive toward O_2 as the oxidizing agent than cytochrome C.

This enzyme can be precipitated by ammonium sulfate, alcohol and acetone, may be dialyzed without great loss in activity and is destroyed by heating. Further work toward purification of this enzyme is in progress.

We are indebted to the Works Progress Administration, to Mr. Fred Johnson for valuable technical assistance, and particularly to the Rockefeller Foundation for a grant in aid which made this work possible.

A. M. ALTSCHUL
H. PERSKY
T. R. HOGNESS

THE UNIVERSITY OF CHICAGO

FACTORS IN COCONUT MILK ESSENTIAL FOR GROWTH AND DEVELOPMENT OF VERY YOUNG DATURA EMBRYOS

IN the course of our investigations on artificial parthenogenesis it became necessary to grow embryos *in vitro* in their early stages of development. In addition, a method by which this could be accomplished might insure the success of many wide crosses hitherto impossible. Although embryos isolated from mature or nearly mature seeds have often been grown *in vitro*, no success with very young embryos has been reported in the literature.

The embryos were removed from ovules of *Datura stramonium* and transferred to a basic medium (B) containing 1 per cent. agar, 1 per cent. dextrose and a mixture of mineral salts according to Tukey.[1] Additional substances were added to this basic medium, as will be mentioned below. The entire procedure was carried out under aseptic conditions. In the basic medium alone, embryos approximately 2 mm long when isolated (the embryos in mature seeds are approximately 6 mm long) showed root and hypocotyl growth but no growth of the cotyledons. No viable seedlings resulted. When, however, a mixture of physiologically active substances[2] was added to the basic medium (BV) cotyledons developed also and viable seedlings resulted when they were kept in dim light.

Pro-embryos[3] and slightly older stages of develop-

[1] *Bot. Gaz.*, 99: 630, 1938.

[2] Concentrations in mg per liter. Glycine (3), Thiamin (0.15), ascorbic acid (20), nicotinic acid (1), vitamin B_6 (0.2), adenine (0.2), succinic acid (25), pantothenic acid (0.5). This mixture was made up arbitrarily and because it proved effective was not further investigated as to essentiality of all components or optimum concentrations.

[3] Terminology follows Souèges, according to whom an embryo is called a pro-embryo as long as it remains radially symmetrical, hence, before the cotyledon primordia develop.

ment could not be grown in this medium (BV), probably because younger embryos are less capable of synthesizing their own growth factors than older ones. Coconut milk[4] proved to be an excellent source of these additional growth factors necessary for very young embryos. For example, results such as the following were obtained: Pro-embryos, 0.14 mm in diameter (0.00144 mm³) were isolated from ovules of $2n$ plants 14 days after pollination and transferred to media B, BV and BV to which was added non-autoclaved coconut milk, and BV to which was added autoclaved coconut milk. After 4 days in the medium containing non-autoclaved coconut milk 4 of 7 embryos were on the average 1.9 mm long and 0.6 mm in diameter. These embryos grew below the surface of the medium. Two other embryos which were placed at the surface of the medium did not grow and 1 culture was infected. Thus, the 4 embryos that had grown had within 4 days increased their volume over 300 times. After 10 days in culture the two largest of the embryos measured 10×1.3 mm and hence had increased in volume 8,000 times. No growth occurred in the other media.

The following is another example: 7 embryos from ovules of $4n$ plants 11 days after pollination were removed. The embryos were in a slightly more advanced stage of development than the $2n$ embryos mentioned above. They measured 0.3 mm in diameter (0.014 mm³) and showed small cotyledon primordia. After 3 days below the surface of the medium (BV) to which non-autoclaved coconut milk was added all embryos cultured had grown on the average 2.0 mm in length and 0.9 mm in width. This corresponds to a volume increase of 90 times. After 10 days in the above medium the two largest embryos measured 8×1.5 mm, corresponding to a 1,000-time increase in volume. The embryos in the two experiments cited showed a good development of cotyledons and hypocotyl. The primary leaves also developed to a length almost equal to the cotyledons. Roots did not develop, but could be made to develop by transferring the embryos to medium (B) or (BV) without the additional coconut milk. A heat-stable root inhibitor which may be auxin is probably present.

In the case of these $4n$ embryos, growth also occurred in half of the cultures kept on medium (BV) to which autoclaved coconut milk was added. However, no differentiation occurred. After 10 days they had developed into lens-shaped bodies about 2 mm in diameter.

The success of coconut milk in furnishing some accessory substances which stimulate the growth of isolated embryos *in vitro* suggests its applicability to other species and prompts this preliminary report. Ultimately it is hoped to secure information regarding the nature of the substances in coconut milk which give it its peculiar properties.

J. VAN OVERBEEK
MARIE E. CONKLIN
A. F. BLAKESLEE

CALIFORNIA INSTITUTE OF TECHNOLOGY AND
CARNEGIE INSTITUTION OF WASHINGTON,
DEPARTMENT OF GENETICS,
COLD SPRING HARBOR, N. Y.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A MINCER ADAPTABLE TO SMALL QUANTITIES OF TISSUE[1]

IN preparing skeletal muscle for oxygen uptake determinations we were confronted with the problem of obtaining a relatively uniform mince of small specimens obtained at biopsy. It became necessary to design and construct the apparatus described here, since we could find no adequate micromincer on the market.

The essential elements of the mincer (Fig. 1) are three telescoping parts: (*1*) The easily removable tubular steel jacket (*A*) which is held in a fixed position during mincing by a pin which fits into a slot in flange *D*. The mince emerges from holes drilled in the side of this tube, and the particle size can be regulated by varying the diameter and number of the holes. (*2*) The steel knife unit (*B*), which is solid at the shank end and slotted, as shown, to engage with pin *E*, and tubular at the opposite end to accommodate the plunger, which forces the contained tissue through

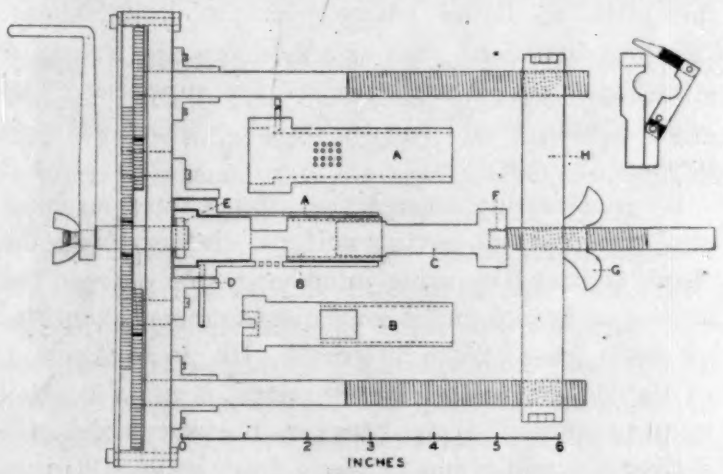

FIG. 1

[4] Coconuts were obtained from the local markets. The activity of the milk from different nuts varied considerably.

[1] Supported by the Wisconsin Alumni Research Foundation.

a square window cut into this tube immediately adjacent to the solid portion. This window is of such a size as to correspond with the area in which the holes are drilled in the outer jacket (*A*). The edge of the square window (or windows) is filed to form a cutting knife or knives if more than one window is made as in the larger units. This tubular knife fits snugly within the outer jacket and rotates freely when activated by the pin *E*. (*3*) The brass plunger (*C*) which telescopes snugly into the open end of the hollow knife is able to rotate with it since it operates freely on the bearing at *F*, thus preventing the maceration of tissues which would occur if the plunger were fixed. The outer jacket and the knife can be made more economically of seamless steel tubing fitted into brass parts to form the shank, thus reducing the amount of machine work necessary. These three mincing parts are readily interchangeable and may be removed quickly from the activating mechanism for loading and cleaning either by retracting the bearing *F* after loosening the thumbscrew *G* or by removing the supporting bar *H* from the threaded rods.

The activating mechanism is mounted on a heavy board by supporting arms attached to the gear box at such a height that the crank may be turned readily. Rotation of the knife and the advancement of the plunger occur simultaneously when the crank is turned. The two threaded rods are geared to the crank and engage the crossbar *H*. By means of this mechanism, the plunger is advanced one sixteenth of an inch for each ten turns of the knife, thus assuring the same uniform rate of tissue advancement and cutting irrespective of the speed at which the crank is turned. This is an absolute essential if a uniform particle size of tissue is to be obtained. Since the plunger can not be advanced without simultaneous operation of the knives it is impossible to squeeze tissues through the openings in the outer jacket without this material being cut, an occurrence common to the Latapie type mincer. The activating mechanism could be improved mechanically by making it possible to alter as desired the ratio of tissue advancement to knife speed. Other modifications, such as a mechanical drive and a lathe-bed type of arrangement for supporting the mincing unit, would add to the convenience but also increase the cost.

By constructing several sizes of the three essential mincing parts, all having uniform dimensions at the shank end, and by using interchangeable casings and knives, we have found it convenient to mince quantities of tissue from 0.25 to 30 grams. Dr. A. E. Axelrod, of the Department of Biochemistry, is using a small mincing unit of 4 mm plunger diameter which will deliver 200 milligrams of tissue from a 250-milligram rat heart. The efficiency of delivery is much greater with larger units, although a small waste of tissue is inevitable because of the small dead space between the knives.

Values for Q_{O_2} obtained on tissues minced with this apparatus compare very favorably with those obtained from the larger Latapie mincer. This mincer will cut soft tissues like brain or liver into discrete particles. Dr. V. R. Potter[2] has found that this apparatus yields a liver mince of "the critical particle size needed to permit adequate inward diffusion of oxygen with minimum loss of cytochrome due to outward diffusion." Fibrous mammary tumors, cartilage and even soft bone, which are refractory to mincing with the Latapie or simple pressure mincers, are reduced readily in the apparatus as described.

The mechanical features were designed by J. S. Hipple, Medical School mechanician, who also constructed the apparatus.

M. H. SEEVERS
F. E. SHIDEMAN

UNIVERSITY OF WISCONSIN

A COMBINED FIXATIVE AND STAIN FOR THE CILIA AND TRICHOCYSTS OF PARAMECIUM

THE combined fixative and stain described here offers numerous advantages over the methods now used for the demonstration of trichocysts and cilia. The structures are stained instantaneously and the normal contour of the animals is faithfully preserved. The trichocyst stain is prepared as follows: Copper sulphate, 5 per cent., 50 cc; hydrochloric acid, 0.1N, 12 drops; blue ink, 5 drops.

If it is desired to stain the cilia only, the hydrochloric acid is omitted from the formula. To use the stain, add two drops to the culture on the slide, place cover glass and examine. The best preparations are usually found around the edges.

JAMES SUMNER LEE

DEPARTMENT OF BIOLOGY,
NORTH CAROLINA COLLEGE FOR NEGROES,
DURHAM

[2] V. R. Potter, *Jour. Biol. Chem.* (in press).

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